CLAIMS

1. A communication network system comprising a first system and a second system which are connected via a global network,

wherein said first system includes:

a terminal apparatus operable to communicate with a device; and

a first communication relay apparatus, which is connected to said terminal apparatus, operable to relay communication between said terminal apparatus and said second system via said global network,

said second system includes:

a router apparatus operable to connect said global network with a local network;

the device which is connected to said local network and is communicated with said terminal apparatus; and

a second communication relay apparatus operable to relay communication between said device and said first system via said router apparatus and said global network, said second communication relay apparatus being connected to said local network,

said first communication relay apparatus has:

a first communication unit operable to communicate with said terminal apparatus using a first protocol;

a second communication unit operable to communicate with said second system using a second protocol via said global network; and

a first conversion unit operable to convert packet data into second protocol packet data as a converted packet, the packet data being acquired from said terminal apparatus by said first communication unit, and to transmit the converted packet to said second communication unit, and also operable to convert packet data into first protocol packet data, the packet data being acquired

from said second system by said second communication unit, and to transmit the first protocol packet data to said first communication unit,

said second communication relay apparatus has:

5   a third communication unit operable to communicate with the device using the first protocol via the local network;

a fourth communication unit operable to communicate with said first system using the second protocol; and

a second conversion unit operable to convert packet data into

10   second protocol packet data, the packet data being acquired from the device by said third communication unit, and to transmit the second protocol packet data to said fourth communication unit, and also operable to convert the converted packet into first protocol packet data, the converted packet being acquired from said first

15   system by said fourth communication unit, and to transmit the first protocol packet data to said third communication unit, and

said second communication relay apparatus is operable to transmit a predetermined packet to said first system via said router apparatus, and

20   said first system is operable to transmit the converted packet to an address of a transmission source of the predetermined packet.

2.   The communication network system according to Claim 1, further comprising

25   a trigger server operable to transmit a trigger packet to said second communication relay apparatus, the trigger packet causing said second communication relay apparatus to function as a client using the second protocol,

wherein said first system is operable to transmit the

30   converted packet based on a request from said second communication relay apparatus responding to the trigger packet.

3.   The communication network system according to Claim 1,

wherein said second communication relay apparatus further has a device ID acquisition unit operable to acquire, from the device, a device ID for identifying the device, and to store the acquired

5   device ID with an address of the device in the local network so that the device ID and the address are associated with each other, and

after receiving the converted packet, said second communication relay apparatus is operable to convert the received converted packet into first protocol packet data, based on the device

10   ID included in the converted packet and the association stored in said device ID acquisition unit, and to transmit the first protocol packet data as a request packet to the device.

4.   The communication network system according to Claim 1,

15   wherein after receiving the packet data using the first protocol, the device is operable to transmit a response packet to said second communication relay apparatus using the first protocol, the response packet indicating the response,

after receiving the response packet, said second

20   communication relay apparatus is operable to transmit the received response packet to said first communication relay apparatus using the second protocol, and

after receiving the response packet, said first communication relay apparatus is operable to convert the received response packet

25   into first protocol packet data, and to transfer the first protocol packet data to said terminal apparatus.

5.   The communication network system according to Claim 2,

wherein said first communication relay apparatus is operable

30   to transmit a trigger request packet to said trigger server, the trigger request packet providing a timing at which the trigger packet should be transmitted, and

after receiving the trigger request packet, said trigger server is operable to transmit the trigger packet.

6.   The communication network system according to Claim 5,
wherein said terminal apparatus is operable to transmit a request packet including request details for the device to said first communication relay apparatus using the first protocol, and
after receiving the request packet, said first communication relay apparatus is operable to transmit the trigger request packet to said trigger server.

7.   The communication network system according to Claim 2,
wherein said second communication relay apparatus is operable to transmit a polling packet to said trigger server, the polling packet enabling said trigger server to recognize existence of the transmission destination of the trigger packet, and to receive the trigger packet from said trigger server as a response to the polling packet.

8.   The communication network system according to Claim 7,
wherein the polling packet includes a device ID for identifying the device, and
after receiving the polling packet, said trigger server is operable to store the device ID included in the polling packet and the transmission source address of the polling packet so that the device ID and the address are associated with each other, and to identify, based on the device ID, the local network connected to the device having the device ID.

9.   The communication network system according to Claim 7,
wherein said router apparatus is operable to relay the polling packet from said second communication relay apparatus to said

trigger server, to store the address of said second communication relay apparatus in the local network with the address of said trigger server in said global network so that the addresses are associated with each other, and to transfer a packet to said first communication

5   relay apparatus according to the association in the case where the packet is received from said global network.

10.   The communication network system according to Claim 7, wherein said second communication relay apparatus is

10   operable to transmit the polling packet using User Datagram Protocol (UDP).

11.   The communication network system according to Claim 2, wherein after receiving the trigger packet, said second

15   communication relay apparatus is operable to transmit an acquisition request packet to said first communication relay apparatus, the acquisition request packet indicating a request to desire to acquire the converted packet,
after receiving the acquisition request packet, said first

20   communication relay apparatus is operable to transmit the converted packet to said second communication relay apparatus, and
after receiving the converted packet, said second communication relay apparatus is operable to convert the received

25   converted packet into first protocol packet data, and to transfer the first protocol packet data as a request packet to the device.

12.   The communication network system according to Claim 11, wherein after receiving the trigger packet, said second

30   communication relay apparatus is operable to repeatedly transmit one or more acquisition request packets to said second communication relay apparatus, each of the acquisition request

packets indicating a request to desire to acquire the converted packet, until notification is received, the notification indicating that there is no information transmittable to said second communication relay apparatus, and

5   after receiving the acquisition request packet, (i) in the case where there is information transmittable to said second communication relay apparatus, the information being acquired from the packet data received from said terminal apparatus, said first communication relay apparatus is operable to transmit the

10   converted packet including the information to said second communication relay apparatus, and (ii) in the case where there is no information transmittable to said second communication relay apparatus, said first communication relay apparatus is operable to notify said second communication relay apparatus that there is no

15   information transmittable.

13.   The communication network system according to Claim 12, wherein after receiving the acquisition request packet, in the case where there is no information transmittable, said first

20   communication relay apparatus is operable to transmit a wait request to said second communication relay apparatus, the wait request being information indicating a request to transmit the acquisition request packet after a predetermined period elapses, and

25   in the case where said second communication relay apparatus receives the wait request, said second communication relay apparatus is operable to transmit the acquisition request packet to said first communication relay apparatus after the predetermined period elapses.

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14.   The communication network system according to Claim 13, wherein after receiving the acquisition request packet

transmitted after the predetermined period elapsed, according to the wait request, in the case where there is no information transmittable, said first communication relay apparatus is operable to transmit the wait request, and

5   after a transmission number of the wait request reaches a predetermined number, in the case where said first communication relay apparatus receives the acquisition request packet transmitted after the predetermined period elapsed according to the wait request, and there is no information transmittable, said first
10 communication relay apparatus notifies said second communication relay apparatus that there is no information transmittable.

15.   The communication network system according to Claim 2,
       wherein said trigger server is operable to transmit the trigger
15 packet using UDP.

16.   The communication network system according to Claim 1,
       wherein said first protocol is Simple Network Management Protocol (SMNP).
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17.   The communication network system according to Claim 16,
       wherein said terminal apparatus is operable to transmit a request packet in the form of an SNMP packet to said first communication relay apparatus, the request packet including
25 request details for the device,
       when transmitting the request packet which is the SNMP packet, said terminal apparatus is operable to store data, into a predetermine field in the SNMP message included in the request packet, the data being a combination of the original field data and a
30 device ID for identifying the device, and
       after receiving the request packet, said first communication relay apparatus is operable to separate the device ID from the

predetermined field of the SNMP field included in the request packet, thus to have only the original field data stored in the predetermined field, and to make respective lengths of the predetermined field and the SNMP message predetermined field lengths.

18. The communication network system according to Claim 16, wherein said first conversion unit is operable to acquire the SNMP message included in the packet data acquired from said second system by said second communication unit, to store data into the predetermined field of the SNMP message, the data being the combination of the original field data and the device ID for identifying the device data, and to transmit the SNMP message in the form of an SNMP packet to said terminal apparatus.

19. The communication network system according to Claim 1, wherein the second protocol is Hypertext Transfer Protocol (HTTP) or Hypertext Transfer Protocol Security (HTTPS).

20. The communication network system according to Claim 1, wherein the device includes the second communication relay apparatus.

21. The communication network system according to Claim 1, wherein said second system further includes a sensor connected to the device,
the device is operable to acquire sensor information measured or detected by said sensor, and also to transmit the acquired sensor information to said second communication relay apparatus using the first protocol,
after receiving the sensor information, said second communication relay apparatus is operable to transmit the received sensor information to said first communication relay apparatus

using the second protocol, and

after receiving the sensor information, said first communication relay apparatus is operable to convert the received sensor information into first protocol packet data, and also to transfer the first protocol packet data to said terminal apparatus.

22. The communication network system according to Claim 20, wherein the device includes:

a sensor information acquisition unit operable to acquire the sensor information from said sensor;

a storage unit operable to store the sensor information;

a sensor information transmission unit operable to transmit the sensor information stored in said storage unit to said second communication relay apparatus using the first protocol; and

a judgment unit operable to judge whether or not a difference between a time when the sensor information is measured or detected by said sensor and a current time exceeds a predetermined threshold, after said sensor information transmission unit transmits the sensor information stored in said storage unit,

said sensor information acquisition unit is operable to acquire sensor information again from said sensor in the case where said judgment unit judges that the difference exceeds the predetermined threshold, and

said sensor information transmission unit is operable to transmit the sensor information acquired again by said sensor information acquisition unit to said second communication relay apparatus.

23. The communication network system according to Claim 1, wherein said second system further includes an actuator connected to the device,

the converted packet includes information for controlling

said actuator,

after receiving the converted packet, said second communication relay apparatus is operable to convert the received converted packet into first protocol packet data, and also to transfer

5   the first protocol packet data as a request packet to the device, and

the device is operable to transmit the information for controlling said actuator to said actuator, the information being included in the request packet.

10   24.   A communication method for a terminal apparatus connected to a first system and a device connected to a second system in a communication network system,

wherein the system has a first system and a second system which are connected via a global network, and

15   said first system includes

a first communication relay apparatus operable to relay communication between said terminal apparatus and said second system via said global network, said first communication relay apparatus being connected to said terminal apparatus,

20   said second system includes:

a router apparatus operable to connect said global network with a local network; and

a second communication relay apparatus operable to relay communication between said device and said first system via said

25   router   apparatus   and   said   global   network,   said   second communication relay apparatus being connected to said local network,

said communication method comprising steps where:

said second communication relay apparatus is operable to

30   transmit a predetermined packet to said first system via the router apparatus;

said first communication relay apparatus is operable to

convert the packet into a second protocol packet as a converted packet, the packet being acquired from said terminal apparatus using the first protocol, and to transmit the converted packet to an address of the transmission source of the predetermined packet

5   transmitted from said second communication relay apparatus; and

said second communication relay apparatus is operable to receive the converted packet transmitted from said first communication relay apparatus, to convert the received converted packet into first protocol packet data, and to transfer the converted

10   packet data to the device.

25.   A first communication relay apparatus which relays communication between a terminal apparatus and a second system via a global network, the first communication relay apparatus

15   comprising:

a first communication unit operable to communicate with said terminal apparatus using a first protocol;

a second communication unit operable to communicate with said second system using a second protocol via said global network;

20   and

a first conversion unit operable to convert packet data into second protocol packet data as a converted packet, the packet data being acquired from said terminal apparatus by said first communication unit, and to transmit the converted packet to said

25   second communication unit, and operable to convert packet data into first protocol packet data, the packet data being acquired from said second system by said second communication unit, and to transmit the first protocol packet data to said first communication unit.

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26.   The first communication relay apparatus according to Claim

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wherein in the case where said first communication unit receives packet data of the same details as the packet data after said first communication unit receives packet data from said terminal apparatus, said first communication unit is operable to abandon the later received packet data.

27.   A program for relaying communication between a terminal apparatus and a second system via a global network, said program causing a computer to execute:

receiving first protocol packet data from said terminal apparatus;

converting the first protocol packet data received from said terminal apparatus into second protocol packet data;

transmitting the second protocol packet data to the second system via the global network;

receiving second protocol packet data from the second system;

converting the second protocol packet data received from the second system into first protocol packet data; and

transmitting the converted first protocol packet data to the terminal apparatus.

28.   A second communication relay apparatus which is connected to a local network and relays communication between a device and a first system via a router apparatus and a global network, the second communication relay apparatus comprising:

a third communication unit operable to communicate with the device using a first protocol via the local network;

a fourth communication unit operable to communicate with said first system using a second protocol; and

a second conversion unit operable to convert packet data into second protocol packet data, the packet data being acquired from

the device by said third communication unit, and to transmit the second protocol packet data to said fourth communication unit, and operable to convert a converted packet into first protocol packet data, the converted packet being converted into second protocol

5   packet data and acquired from said first system by said fourth communication unit, and to transmit the first protocol packet data to said third communication unit,

said fourth communication unit is operable to transmit a predetermined packet to said first system via the router apparatus,

10   and to receive the converted packet transmitted from the first system to an address of the transmission source of the predetermined packet.

29.   A program for relaying communication between a device and

15   a first system via a router apparatus and a global network, the program comprising:

notifying the first system of a predetermined packet via the router apparatus;

receiving second protocol packet data transmitted from the

20   first system to an address of the transmission source of the predetermined packet;

converting the second protocol packet data received from the first system into first protocol packet data;

transmitting the first protocol packet data to the device via a

25   local network;

receiving first protocol packet data from the device via the local network;

converting the first protocol packet data into second protocol packet data, the first protocol packet data being received from the

30   device; and

transmitting the second protocol packet data to the first system.